The digital transformation process in the agri-food sector: A case study

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Abstract

The paper investigates the ongoing digital transformation process in a firm operating in the agri-food sector by analyzing the approach adopted, the barriers and challenges faced when implementing digital technologies, and the impact of the Covid-19 crisis on this process. The authors opted for a qualitative approach based on a single case study. The results suggest that the preferred approach of top management played a crucial role in supporting the changes brought about by the transformation. Specifically, it is a conscious, incremental, and critical approach that combines digitalization and craftsmanship. The research reveals four barriers to the implementation of digital technologies: resistance to change, a lack of digital skills, an inadequate organizational structure, and financial constraints. Furthermore, the results show that the Covid-19 crisis has accelerated the implementation of digital technologies, which was already in progress during the pre-pandemic period.

Keywords: Digital transformation, Digital technologies, Covid-19, Agri-food sector, Case study.

1. Introduction

The economic disruption caused by the Covid-19 pandemic proved to be a trigger factor in accelerating the need for digital transformation (DT) in firms (Modina, 2020; Papadopoulos *et al.*, 2020; ISTAT, 2021; Apostolopoulos e*t al.*, 2021). DT requires the adoption of digital technologies (IoT, robotics, big data analytics, augmented reality, cybersecurity, etc.) that play a crucial role in guaranteeing production continuity and the supply of

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private and public services (ISTAT, 2021), especially during periods of total or partial lockdown. In these times of crisis, rapid changes have occurred in terms of customer behaviour, market balance and supply chains (Apostolopoulos e*t al.*, 2021; Coluccia *et al.,* 2021). Digital technologies have proven to be useful in helping firms to adapt their processes (Lombardi, 2021, Lombardi *et al.*, 2021) and business models to the "new normal" (Klein, Todesco, 2021). They enhance competitiveness, productivity and performance (Chan *et al*., 2019; Schroeder *et al.*, 2021) and address and overcome the Covid-19 crisis (Klein, Todesco, 2020; Papadopoulos *et al*., 2020). But DT is a complex issue and affects the whole organisation (Matt *et al*., 2015). Even though significant advantages are expected, numerous firms are still struggling to realise their transformation potential in the face of various obstacles (Hess *et al*., 2016; Annosi *et al.,* 2020) and challenges that are often closely linked to the industry they belong to (Lezoche *et al.*, 2020; Chen *et al*. 2021).

As opposed to other industries, the agri-food sector has diverse characteristics that determine innovation activities (Lezoche *et al.,* 2020). Studies (Esteso *et al.,* 2017; Esteso *et al.,* 2018) have identified different types of crop-based uncertainty facing these businesses, such as shelf-life, deterioration rate, harvesting yield, supply lead time, market prices, weather, pests and diseases, regulations, etc. (Esteso *et al.,* 2018). Therefore, the agri-food supply chains have been strongly urged to manage these sources of uncertainty and risk, whose precise evolution is unpredictable and can compromise the future sustainability of this kind of supply chain (Lezoche *et al.,* 2020; FAO, 2021). With this in mind, FAO (2018) stressed the need to move away from "business as usual" by developing and implementing innovative technologies. DT can assist with monitoring and managing the myriad risks to which such businesses are particularly exposed, thus improving the firms' performance (e.g., technical and allocative efficiency, competitiveness and quality of production), and also the sustainability of the entire system (e.g., economic efficiency, equity, environmental) (Hernandez *et al.,* 2018; Annosi *et al.,* 2019; Lezoche *et al.,* 2020; Schroeder *et al.,* 2021).

Nonetheless, whilst the positive impact of innovative technologies has not been questioned, their penetration is still poor (Annosi *et al.*, 2019; ISTAT, 2019; Bahn *et al.*, 2021). Furthermore, previous research has revealed high failure rates in DT within firms' processes (Bahn *et al.,* 2021). The digital transformation process, which promises to transform the agri-food sector in unprecedented ways (Schroeder *et al.,* 2021; Bahn *et al.,* 2021), still poses numerous challenges and raises critical issues that have yet

to be confronted (World Bank, 2019; Annosi *et al.,* 2020; Herrero *et al.,* 2021).

Several studies have analysed the barriers that can hinder a firm from adopting and implementing digital technologies (Vogelsang *et al.*, 2019a, b; Agrawal *et al*., 2020), also in the agri-food system (Annosi *et al*., 2020; Annosi *et al.*, 2021; Schroeder *et al*., 2021). SMEs, in particular, have higher digital innovation barriers (e.g., technical technologies, cultural and management, economic and financial, regulation, etc.) than large firms because of their limited resources and lack of capabilities (Ramilo, Embi, 2014; Chen *et al.*, 2021). Furthermore, the crisis, in many cases, has exacerbated these weaknesses by making SMEs more vulnerable and exposed to the risk of default. Yet, at the same time, the Covid-19 pandemic has focused attention both on the need for and the usefulness of digital technologies within the agri-food sector (FAO, 2020; Apostolopoulos *et al.,* 2021; Bahn *et al.,* 2021; Remondino and Zanin, 2022).

However, because the topic is extremely new, there is limited evidence concerning the progress of companies towards digitalisation during Covid-19. In order to fill this gap, this paper aims to answer the following research questions:

[RQ1] What is the approach to digital transformation in the agri-food sector?

[RQ2] What barriers and challenges are being faced in implementing digital technologies?

[RQ3] How does the Covid-19 crisis impact the ongoing process towards digitalisation?

A qualitative approach based on a single case study (Yin, 2003; Eisenhardt, Graebner, 2007; Miles *et al*., 2014) was adopted to respond to our research questions. This paper is structured as follows: section 2 presents the theoretical background, section 3 describes the research methodology and section 4 illustrates the study's findings. Lastly, the conclusion proposes a discussion of the results, the implications, and the limits of this study.

2. Theoretical background

2.1. Digitalisation in the agri-food sector

The agri-food system is a complex industry that includes a wide range of processes and operations and involves an extensive variety of stakeholders, such as farms/manufacturers, producers and retailers, as well as governments (Hernandez *et al.,* 2017), which are intrinsically linked to key global

challenges in terms of defining and implementing innovative solutions. DT plays a key role in the operations and decision-making of the agri-food sector (Panetto *et al.,* 2020; Annosi *et al.,* 2021).

The intrinsic complexity of this system is apparent in the sources of uncertainty and the risks that supply chain firms face. Several studies have laid bare the agricultural sources of uncertainty (Esteso *et al.,* 2017; Esteso *et al.,* 2018). In the research by Esteso *et al.* (2018), four types of crop-based uncertainty have been identified: product (shelf-life, deterioration rate, lack of homogeneity, food quality and food safety), process (harvesting yield, supply lead time, resource needs and production), market (demand and market prices) and environment (weather, pests and diseases and regulations). All these sources of uncertainty and risk need to be appropriately monitored and managed to ensure a resilient and sustainable agri-food system. Digital technologies have an enormous potential to address these issues (Annosi *et al.,* 2020; Annosi *et al.,* 2021; Schroeder *et al.,* 2021).

Even areas of congenital inefficiency, which have always characterised the sector, for example, information asymmetries and transaction costs, can be overcome through the coherent introduction of digital technologies (Schroeder *et al.,* 2021). For instance, on the farm, new technologies that improve information processing allow farmers to respond to the spatial and temporal variability of production. By so doing, they increase efficiency and productivity and assist on-farm decision-making processes (Saito *et al.,* 2015; Brandes *et al.,* 2016). Off the farm, digital technologies can increase farmers' access to upstream and downstream markets by drastically lowering information-related transaction costs (Deichmann *et al.,* 2016).

Moreover, the adoption of digital technologies in the agri-food system can help improve not only the performance of individual businesses (e.g. technical and allocative efficiency, competitiveness, etc.) but also the sustainability of the entire system (e.g., economic efficiency, equity, environmental sustainability) (Hernandez *et al.,* 2018; Annosi *et al.,* 2019; Lezoche *et al.,* 2020; Schroeder *et al.,* 2021). For example, blockchain technology can transform quality control and traceability. Decentralised food tracing throughout the supply chain creates opportunities for safer, more sustainable food (Zhao *et al.,* 2019).

Furthermore, the adoption of digital technologies can promote the creation of a digital ecosystem (Annosi *et al.,* 2021), resulting in closer coordination among the firms in the supply chain and fostering the development of practices, strategies and processes that are genuinely collaborative and inter-organisational (Zhou *et al.,* 2014). A greater degree of integration would also certainly benefit the environmental sustainability of the food supply chain

itself, thus helping to reduce the carbon footprint as well as waste production (Gokarn, Kuthambalayan, 2019; Kamble *et al.,* 2020).

Nonetheless, despite the potential benefits deriving from the use of these technologies, there are still numerous challenges to be faced. In their literature review, Annosi *et al.,* (2020) identified several challenges to the sustainable development of digital technologies. Access emerged as a key challenge because of the high costs of equipment, maintenance and connectivity. Since access to infrastructure represents a comparative advantage for businesses, those in rural areas that have no access may well find themselves at a disadvantage (Hay, Pearce, 2014). Other challenges are linked to the business model adopted by firms. If business models are not re-thought in such a way as to accommodate the innovations, any type of investment in this direction is destined to fail (Long *et al.,* 2016).

The lack of supporting institutions can represent a further challenge, especially in developing countries. Aryal *et al.* (2020) stress that this is a problem both for the farmers and the system level because technologies and practices such as climate-smart agriculture would promote both environmental and economic sustainability. In this sense, Murugesan and Sudarsanam (2020) have also confirmed the existence of the same relationship and argue the need for institutions to promote the upscaling and outscaling of technologies through investments, policies and the institutional framework at all levels: micro (the farmer), meso (industry), macro (system) and at national and local levels.

2.2. Approach to digital transformation in SMEs

DT is a complex issue and affects the whole organisation (Matt *et al*., 2015; Kane *et al*., 2015, 2019; Jones *et al.,* 2021). It is characterised by a wide, in-depth use of IT that promotes a radical change in operations and interactions with customers and suppliers (Fitzgerald *et al*., 2014; Hess *et al*., 2016; Singh, Hess, 2017). Following the implementation of digital technologies, DT is intrinsically linked to the strategic changes to the business model (Sebastian *et al*., 2017). Thus, embracing DT goes far beyond the simple use of one or more technologies; it requires the adoption of a digital strategy (Kane *et al*., 2015, 2019).

According to Matt *et al.* (2015) – independent of the sector or firm – to ensure a successful DT strategy and enjoy its beneficial effects, it is crucial to closely align four different dimensions: use of technologies, changes in value creation, structural changes, and financial aspects. If all of these four

dimensions are taken into account within the framework, this will support firms in assessing their current abilities and formulating a digital transformation strategy (Matt *et al*., 2015).

Several studies have pointed out that, as a result of the privileged position that allows them to shape strategy, top managers/owners can influence decisions concerning the adoption of technology (Damanpour, Schneider, 2008; Midavaine *et al.,* 2016). With this in mind, a branch of the literature that investigates top managers' intentions towards adopting digital technologies has focused on variables such as education, age, gender, etc. However, these can only partly account for differences in adoption behaviours since decisions in this area also reflect cognitive elements and top management values (Li *et al*., 2014). Understanding the attitudes (for instance, proactive or not), reasoning, characteristics and values of top managers/owners is crucial to understanding why some firms opt to implement new technologies while others do not. According to Annosi *et al.,* (2019), managers/owners proactively looking for the newest technologies on the market may successfully adopt such innovation (Annosi *et al.,* 2019).

Managerial influence on strategic technological change is more emphatic at the SME level where the top manager or owner-manager is considered an all-rounder, involved in all organizational processes and having a decisive say in the firm's decision-making processes (Jeyaraj *et al*., 2006).

Bedetti *et al*. (2020) have reported on how managers or owners of agri-food SMEs actively promote the adoption of digital technologies. They have identified differences between "low technology integration" and "high technology integration" firms. In the first category, scholars have observed strong beliefs in technologies, a learning culture, a proactive approach and a rationale conducive to adopting digital technology. In the second group, they have observed the absence of these elements and a high degree of disorientation towards the usage of technological innovation.

Furthermore, the DT process requires an innovative cultural approach (Garzoni *et al*., 2020). The role of the business leadership is also crucial in this sense; Kane *et al*. (2015, p. 3) have argued that, *"The ability to digitally reimagine the business is determined in large part by a clear digital strategy supported by leaders who foster a culture able to change and invent the new"*.

Although DT most often implies radical changes in the organisation, these changes should be gradually implemented by the top management. In this vein, Kane *et al.* (2019) have described how, due to the introduction of DT, firms move towards a four-stage evolutionary path associated with an

increasing level of changes: exploration of DT, development of digital initiatives, digital maturity, and being a digital business (Kane *et al*., 2019).

Despite the recognised strategic importance of digital transformation and its potential benefits in terms of business continuity and sustainability, as yet there is limited understanding of how organisations face digital transformation (Warner, Wäger, 2019), especially in the agri-food sector (Annosi, Brunetta, 2020).

2.3. The barriers hindering the implementation of digital technologies in SMEs

Digitalisation, aimed at optimising business processes and performance, encounters numerous obstacles. Several studies have analysed the barriers that can hinder a firm from adopting and implementing digital technologies (Vogelsang *et al.*, 2019a, b; Agrawal *et al*.,2020; Raj *et al*. 2020; Chen *et al.*, 2021) also in the agri-food sector (Annosi *et al.,* 2020; Annosi *et al.,* 2021; Schroeder *et al.*, 2021). SMEs, in particular, have higher digital innovation barriers than large firms because of their limited resources and capabilities (Ramilo, Embi, 2014; Chen *et al.*, 2021).

Lack of financial resources and funding is one of the most common barriers to the implementation of digital technologies in SMEs (Lammers *et al*., 2019; Volgelsang *et al.*, 2019; Agrawal *et al*., 2020; Jones *et al.*, 2021). This is often associated with another barrier concerning implementation and running costs, usually perceived as too high (Ghobakhloo *et al.*, 2019; Annosi *et al.*, 2020; Chen *et al.*, 2021; Schroeder *et al.*, 2021). In fact, DT can entail major costs due, for example, to the need to make new investments in equipment, staff training and hiring qualified personnel (Kache, Seuring, 2017; Raj *et al.*, 2020). Added to this is the lack of clarity regarding economic benefits. Many firms are unwilling to adopt digital technologies if they perceive the necessary investment to be higher than the benefits it generates (Parida *et al.*, 2010; Annosi *et al*., 2020; Raj *et al.*, 2020; Annosi *et al.,* 2021).

Lack of human resources is another barrier related to the partial or total absence of qualified employees and lack of digital competencies (Volgelsang *et al*., 2019a; Raj *et al*., 2020; Agrawal *et al.*, 2020; Annosi *et al.,* 2020). A successful DT requires new competencies (Palazzi *et al*., 2021), such as digital capabilities, analytics skills and decision-making capabilities; however, they are rarely present in small firms. Moreover, SMEs find it more difficult to attract digital talent because they want adequate remuneration and career

paths that firms cannot offer because of financial constraints (Raj *et al.,* 2020; Chen *et al.,* 2021).

Also, the lack of technical and technological resources is an obstacle, strongly linked to financial limitations (Volgelsang *et al.*, 2019a; Chen *et al*., 2021). This barrier is often combined with the absence of an appropriate organisational structure that promotes in-house collaboration and interaction between the organisation and the external environment (Volgelsang *et al*., 2019a; Agrawal *et al*., 2020; Annosi *et al.,* 2020). This absence poses a major challenge in terms of value-chain integration, especially when a firm's digital transformation relies on integration with all partners upstream and downstream in the production process (Raj *et al.*, 2020), such as in the case of the agri-food supply chain (Annosi *et al*., 2020; Schroeder *et al.*, 2021; Remondino, Zanin *et al.,* 2022).

The lack of an effective strategy is one of the most common obstacles to SMEs' digital transformation (Volgelsang *et al.*, 2019b; Jones *et al.*, 2021), and probably one of the most difficult to overcome. Digitalisation offers numerous possibilities; however, firms are failing to take advantage of the benefits (Klein, Todesco, 2020; Schroeder *et al.*, 2021) because they do not have an effective strategy (Agrawal *et al*., 2020; Annosi *et al.,* 2019). All too often decision-makers focus their attention on an individual technology without taking into account the need to rethink the firm's strategy from a digital perspective (Jones *et al.,* 2021). Starting a DT is a strategic decision (Kane *et al.,* 2015); however, top management is often unable to support the firm in this process (Agrawal *et al.*, 2020) because of the following factors: no sense of the urgency of digitalisation (Fitzgerald *et al.*, 2014); lack of leader' digital skills (Ulvenblad *et al.*, 2018); lack of clarity regarding benefits (Raj *et al*., 2020); fear and/or resistance to innovation (Ulvenblad *et al*., 2018).

The aforementioned barriers arise from the internal organisation environment; others could stem from the external environment, such as lack of standards and government regulation across the industries regarding the use of digital technologies (Raj *et al.*, 2020), lack of appropriate incentives and missing institutions (Annosi *et al.*, 2020).

2.4. Digital technologies and Covid-19 effects

According to the Digital Economy and Society Index (DESI, 2020), Italian firms rank 22nd out of a total of 28 States, with a score well below the European average (31.2 vs. 41.4). The report points out that firms are behind in the use of the latest technologies, both in production processes (e.g., big

data and cloud computing) and as a means of marketing their products (e.g., e-commerce). Cirillo *et al*. (2021) have confirmed that Italian firms, in the pre-pandemic period, show a "single-technology" approach to digitalisation which is strongly associated with firm size.

What happened during the Covid-19 crisis? The earliest available data for the pandemic period (ISTAT, 2021) show that the digitalisation process was given fresh impetus by the Covid-19 emergency. However, this effect was not homogeneous and depended, to a large extent, upon the degree of digitalisation achieved before the crisis. The businesses most committed to digital transformation—usually the larger firms with a solid financial structure—are those that have shown a greater reactivity to the exogenous shock (ISTAT, 2021). SMEs' increased recourse to certain digital tools such as e-commerce, digitalised document management and cloud services-resources that require neither large investments nor specific digital skills. However, the more high-tech digital applications – i.e., robotics, big data, 3D printing, etc. – are still restricted among SMEs (ISTAT, 2021).

The agri-food sector – 90% composed of micro, small and medium-sized firms (Giombini *et al.,* 2021) – is one of the most important industries in the Italian economy (Italian Coldiretti, 2021). In the last decade, this sector, too, has been powerfully affected by the development and spread of new technologies (Annosi *et al*., 2020; Remondino, Zanin, 2022), triggering a radical rethinking of business practices and processes along the entire supply chain. Nevertheless, despite the rapid development of digital technologies in Italy, this sector is still lagging from a technological and innovative point of view, and no ground was made up during the pandemic (ISTAT, 2020). According to the ISTAT report, 88% of Italian agri-food firms can be classified as having a "very low" or "low" level of digitalisation; only the remaining 12% have obtained a "high" or "very high" score, and they include extremely few micro firms and SMEs.

During the pandemic, this sector has had, and still has, to face new challenges both on the demand and the food supply chain side (Galanakis, 2020; Coluccia *et al.,* 2021; Remondino, Zanin, 2022).

As regards the demand for agri-food, there was a huge increase in the purchase of conservable foodstuffs (pasta, rice, canned fish, sugar, etc.) as a result of widespread fears of food shortages (Hobbs, 2020; ISMEA, 2020a). Furthermore, the pandemic has brought about a change in consumers' relation to food: they are now more careful and more aware of their diet and its environmental impact (CREA, 2020; Coluccia *et al*., 2021). Although the trend was already underway (Scalvedi, Saba, 2018), the move towards green products was certainly propelled by the Covid-19 crisis, which has made the

consumer even more mindful of the quality and safety of food products (Enpaia-Censis, 2020; SINAB, 2020). In fact, during the pandemic, 90% of Italian consumers bought an "organic" product on more than three occasions, a statistic which rises to 97% if we consider families who bought one at least once (SINAB, 2020).

Where food supply chains are concerned, sudden increases in demand since the outbreak of Covid-19 have thrown them into a certain amount of disarray, highlighting their weaknesses and calling into question their resiliency (Coluccia *et al.,* 2021; Remondino, Zanin, 2022). The disturbance proved most evident in factories, farms and distribution centres (Coluccia *et al*., 2021). For instance, absenteeism – as a result of illness, quarantine or a mandatory reduction in workers – caused major organisational difficulties in farms and factories, slowing operations and creating bottlenecks.

A precarious, increasingly turbulent environment (demand-side shocks, potential supply chain disruptions, health and environmental crises, and so on) severely tests the response capacity of these businesses, which are usually SMEs. Scholars have argued that the fragility of the food supply chain can be offset by innovation and technology, which, when applied to the agriculture sector and the food industry, can improve the quality and efficiency of the chain (Barba *et al.,* 2015; Coluccia *et al.,* 2021; Remondino, Zanin, 2022). Big data, blockchain technology, the Internet of things and cloud computing, harnessed in the interests of business services and processes, could help all actors responsible for integrating the food chain to manage their businesses and create a favourable digital ecosystem (Zhou *et al.,* 2014; Saito *et al.,* 2015; Brandes *et al.,* 2016; Deichmann *et al.,* 2016).

3. Methodology

3.1. Research method, case selection, data collection and analysis

The empirical research is based on the qualitative analysis of a single case study (Yin, 2003; Eisenhardt, Graebner, 2007; Miles *et al.,* 2014).

This methodology was chosen by the authors because it was deemed suitable for the aim of the research. It is recommended when the aim is to understand complex phenomena (Eisenhardt, 1989). Following the classification illustrated by Yin (2003), we adopted the descriptive case-study method, which describes an event in its real-life context. Moreover, a case study approach was used in analysing the digital transformation in SMEs (Chan *et al*., 2019) operating in the agri-food sector (Cupertino *et al.*, 2018).

The case study was selected according to the logic of a predetermined criterion of importance (Patton, 1990; 2015); it represents an information-rich case conducive to a better understanding of the questions under examination.

The selected case is the Gino Girolomoni cooperative company (hereafter Girolomoni), founded in 1977, which operates in the organic agri-food sector. With 56 employees and about 19 million euros in revenue in 2020, it classifies as a medium-sized firm, according to the European Recommendation criteria (2003). There are several reasons why this specific firm is well suited to the purpose of the research. First, though it was a well-established business and in constant evolution, before the pandemic, the firm had already decided to undertake a digital transformation and engage fully with the consequent barriers and challenges. Second, the Covid-19 crisis proved to be a trigger factor that made top management fully aware of the need for digital transformation. Thus, the challenging process, influenced by an exogenous factor – the Covid pandemic – qualifies this case as an eligible focus of description. Third, as stressed by recognised qualitative researchers (Bérdad, Gendron, 2004; Laine *et al.*, 2017; Major *et al.,* 2018), the firm's readiness to be examined was a significant factor in its selection for the case study.

In line with the case study approach, we combined different data sources, such as interviews, archives (annual reports, minutes of meetings) (Eisenhardt, 1989; Yin, 2014), the official website and online news. This study obtained primary data through semi-structured interviews. Before starting primary data collection, secondary data were gathered – such as financial statements 2019-2020, minutes of meetings, the official website and online news – to learn more about the firm's characteristics and environmental context. These multiple data sources were gathered so as to provide an effective triangulation, confirm emergent findings and avoid inconsistencies in the data (Miles, Huberman, 1994).

Guided by a checklist, interviews were carried out on an online platform by three of the authors and involved the President of the board of directors, the information technologies manager and the production manager. Instead of strictly following the questions, the interviewer used open-ended questions and allowed for discussion to embrace a broader and more in-depth understanding of the topic. This method was chosen to give the subjects the freedom to reveal their opinion on their own terms and thus provide the researcher with a fuller understanding. The interviews, lasting about an hour, were recorded with the consent of the interviewees and then transcribed verbatim for the subsequent analysis process.

According to the method of qualitative research, the data analysis followed an iterative approach. Firstly, each researcher read the interview transcription independently and also took into account the secondary data collected, so developing an individual case study summary before consultation with colleagues. Subsequently, all the authors pooled their thoughts in a series of brainstorming sessions and discussed the range of interpretations suggested by the findings. The constant alternation of individual and collective analysis enabled the research team to arrive at collegial conclusions.

In the narrative, as described below, quotations from interviews have been translated from Italian to English by the authors.

3.2. The research context

Girolomoni is an agricultural cooperative located in the province of Pesaro and Urbino in central Italy. It has been operating in the organic agri-food sector for more than 40 years. It was founded by Gino Girolomoni in 1977, under the trademark Alce Nero, which was then sold in 2005 to become Montebello, and since 2012 it has traded under the name of its founder, an acknowledged trailblazer for the organic movement in Italy. The firm is now managed by the founder's son.

Girolomoni's core business is making pasta from the cereals and durum wheat semolina supplied mainly by one of its associates, the Cooperativa Montebello. In fact, pasta sales account for more than 90% of Girolomoni's overall turnover. Besides pasta, the company also markets other products such as pulses, cereals, flour soft wheat, extra virgin olive oil, rice, tomato-based products, and coffee, all of which is rigorously derived from organic agriculture. They are supplied by small firms that are run entirely along organic lines and/or that espouse the same principles and values with regard to biological farming and agricultural practices committed to safeguarding both the environment and consumers' health. Girolomoni is now strongly oriented to the international market. In fact, 83% of its sales are made abroad, the main markets being the USA, France and Germany.

The Covid-19 crisis found itself dealing with a firm with a solid financial and economic structure and excellent prospects for development. Unlike other sectors, the effect of the pandemic on the agri-food sector proved to be positive. By comparison with the previous year, 2020 saw an extraordinary rise in orders for Girolomoni in all its main markets: USA (+54%), France (+27%), Germany (+26%) and Italy (+33%). Such an extraordinary surge resulted in a sudden saturation of production capability and an increase in

business complexity, putting the entire chain value under considerable pressure.

4. Findings

Girolomoni went into the Covid-19 crisis equipped with a sound financial structure, a positive trend in terms of sales and investment in innovation, as well as a strong commitment to its community. The decision to undertake a digital transformation involving all areas of the organisation originated in the business strategy, which in turn reflects the vision and founding values of Girolomoni. The firm's commitment to innovation is apparent on its official website, in the financial statements (2019 and 2020) and in the analysed management report.

The need to implement digital technologies is intrinsic to our business strategy, one that reflects our mission. In other words, we act as an agricultural cooperative with many farmers, around 300, today, and not simply as a pasta factory […]. We have chosen to create our own supply chain – working exclusively with direct farmers and our mill – i.e. from the field to the pack of pasta […]. However, this requires an enormous amount of work, which would be completely unmanageable in the absence of a proper digitalisation process. (President).

Girolomoni's case represents an example of a medium-sized agri-food enterprise coming to grips with the complex process of DT in a turbulent context. From the analysis of interviews, several elements have permited us to piece together their management approach to DT.

First, it is a conscious approach that recognises, on the one hand, the complexity of implementing new technologies within the firm, and on the other, that knows the benefits, economic and otherwise, deriving from their implementation. While from the outset top management had appeared conscious of "the need" for DT for the survival and growth of the company, the effects of the Covid-19 crisis transformed this awareness into "a sense of the urgency" of digital transformation.

The road to digitalisation is in constant evolution. […] It's a great challenge for us […] we set out in the knowledge that it was the only way we'd be able to remain in the market, ensure the development of the firm and, of course, stay faithful to the founding values of our company. (President).
The managerial approach is strongly oriented to digitalisation and implementing these changes. (Production director).

Second, it is an incremental approach that recognises the importance of introducing changes gradually and systematically. This step-by-step method is adopted for every digitalisation project undertaken by the firm.

The digitalisation process has been implemented gradually important stages have never been taken all at once […] it has been an incremental process and will still be […] the various changes and experiences step-by-step […] (President).

The introduction of the Manufacturing Execution System (MES) in the production area calls for a gradual approach nothing will be immediate […] we need to adapt the technologies to the specific requirements of the firm […] even staff skills have to be adapted […] The road ahead is long and to some extent uncertain, but with method and teamwork, we have a good chance of achieving our goals. (IT manager).

Third, it is an approach that combines digitalisation and craftsmanship. Over the years, Girolomoni has constantly invested in innovation and technology without renouncing its origins and founding values – cherishing agriculture in rural areas and preserving the environment.

[…] from the very beginning the company has been fired up by an authentic love for the land and deep respect for the people who live there, always remaining one step ahead in the choices it makes in favour of the quality of life and the environment, with a type of sustainable agriculture. (Official website).

For Girolomoni, the question is not the tool – in this case, digitalization – but rather how to use the tool to achieve your goals and fulfil your mission.

If we look at the pasta factory or the mill which we made in 2019, we didn't make an artisanal mill or an artisanal pasta factory, but opted for real industrial processes, we're not ashamed to say so. The point is that if the industrial process is used skillfully, you have machines that allow you to arrive at a quality close to artisanal. In our specific case, to give you an idea, we could dry the pasta in 3-4 hours – the short pasta – and 5-6 hours for the long pasta … we have decided to run the machines at half their potential. Nobody obliges us to do this, least of all, not the organic farming laws, it's simply a product quality choice. […] As a result, we find ourselves halfway between two worlds, between committed industrialisation and efficient artisanship, and we try to keep a balance from this point of view. (President).

Finally, a critical approach has emerged regarding what is being done and what should be done to maximise the benefits deriving from the digital transformation.

Given the high investments that involve the whole company, digitalisation would require the adoption of an ad hoc committee dedicated to guaranteeing the process continuity. (Production director).

Particular attention is paid to managing and using the data produced and collected thanks to the introduction of new technologies in the various business processes (production area, quality control, packaging and agricultural supply chain).

We realise that we do not exploit all this data we are producing [...] we have and are digitising business processes, but we're also creating a large amount of data which we're not fully exploiting at present [...] we need to systematise all this information to derive its real value [...] this is an important step that we should be carrying out. (President).

All these characteristics shed light on some widely discussed aspects in the literature. Top management plays a crucial role in the digitalisation process (Fitzgerald *et al*., 2014; Hess *et al*., 2016; Singh, Hess, 2017; Annosi *et al*., 2020), particularly in a medium-sized enterprise, where the top owner-manager is intensely engaged in different areas and processes (Jeyaraj *et al*., 2006; Bedetti *et al*., 2020). Girolomoni's leadership is genuinely convinced that adopting new technologies is the right way to guarantee business continuity. This awareness allowed the firm to have a proactive approach toward DT, especially in a period of significant instability.

Moreover, prior studies have underlined that understanding the attitudes and values of top management is crucial to understanding why some firms opt for starting the digital transformation (Li *et al.,* 2014; Annosi *et al.,* 2019). Findings have confirmed this empirical evidence; this appears especially true in sustainable agriculture, which proposes a model based on an ethical code aimed at improving the conditions of workers and the environment in which they operate.

The implementation of digital technologies – extending to both the farming chain and the internal organization – encountered barriers and challenges from the word go, seriously testing the managerial and reactive abilities of the decision-makers and the organization as a whole.

The first barrier encountered was the resistance of human resources to change. In many cases, innovations have radically altered how certain jobs are performed, generating feelings of distrust and rejection of "the new". A key example is the inspection and control work carried out by agronomists, whose task of collecting information in the field and then relaying it to other departments (e.g., production and/or quality control office) has undergone a significant change:

[…] For example, the agronomists who used to go out in the field, and record data on a sheet of paper, which they would then hand to us ...we're now asking them to do it directly on a specific program, using a tablet or laptop. (President)

[…] Then you'll hear people say: but the computer doesn't work – it's slow and disconnected… but I work better the old way […]. (President).

The second barrier is the lack of digital skills. In fact, Girolomoni had to take into account a lack of qualified personnel capable of managing the digital transformation process at different levels. The digitalisation project, known as the Manufacturing Execution System (MES) and launched in the production and packaging areas, was emblematic of this problem:

[…] The real challenge is training and expanding the background of people from a digital point of view. (Production director)

To be carried out, manufacturing projects require at least basic digital skills […] There's no point in introducing sophisticated equipment and ultra-powerful, cutting-edge software if the employee isn't really equipped to use them […] you create a sort of human resistance which risks reducing or even eliminating the potential benefits deriving from the introduction of new technologies. [IT manager].

This hurdle is linked to the third obstacle in an organisational structure that is not yet fully formalised. The transformation process is requiring firms to define new roles and operations which must inevitably be aligned with existing ones. This raises several issues concerning the assignment of tasks, responsibilities and the distribution of workloads among the workforce.

We are a growing business, but we are still different from the big firms in which the division of labour is structured and clearly defined […]; here we need to be versatile; for example, I deal with IT development processes, product development processes, then, of course, I'm also busy with day-to-day business […] It's sometimes difficult to decide who can do what, whose role it is, who is responsible for performing certain tasks and who has the time to give to a specific project […]. (IT manager).

All of these obstacles are in line with what several studies identified in SMEs (Agrawal *et al.*, 2020; Raj *et al.*, 2020; Palazzi *et al.*, 2021) and the agri-food sector (Annosi *et al.,* 2020). The challenges linked to the implementation of new technologies mainly arise from the barriers encountered in the use of digitalisation (Schroeder *et al.,* 2021).

The fourth barrier concerns financial constraints. Although the firm was in good financial health, the high level of investment required to set in motion and sustain the DT process was such as to call for frequent feasibility studies and budget revisions. The determination of the decision-makers and their awareness of the advantages, economic and otherwise, of such investments was crucial in preventing the interruption or suspension of the digitalisation project.

These findings, from a specific case study, are also aligned with those from previous research (Volgensang *et al.,* 2019) also in the agri-food sector (Annosi *et al.,* 2020; Schroeder *et al.,* 2021). The perception of both the outlay required to implement DT and the subsequent running costs appears to be a critical factor (Ghobakhloo *et al.,* 2019, Annosi *et al.,* 2020), even when the firm, like Girolomoni, is in robust health. But unlike the situation reported in other studies (Parida *et al.,* 2010; Raj *et al.,* 2020; Annosi *et al.,* 2021), Girolomoni's top management has always been fully aware of the advantages (economic and otherwise) of such investments. Awareness and commitment have been such as to overcome, at least in part, the difficulties stemming from financial constraints and those relating to human resources.

The case of Girolomoni confirms the findings of other empirical studies conducted on a larger scale (Modina, 2020; Papadopoulos *et al.,* 2020, ISTAT, 2021); the booster effect was observed in the firms familiar with the use of digital technologies, an enjoying a solid financial structure.

In fact, for Girolomoni, the Covid-19 crisis accelerated the process of digitalisation, which was already underway in the pre-pandemic period. Overall, the crisis had a positive impact on the business. The growth resulting from a national and international sales boom (as emerged from an analysis of the interviews, Financial Statement 2020 and Management Report 2020) provided top management with the funds to invest in the human and technological resources needed to overcome some obstacles (described above) and so proceed along the path of DT.

The Covid crisis sped up certain processes, some of which had already been set in motion. […] The digitalisation process is independent of Covid. (President).

The Covid period was not without its difficulties. Girolomoni found itself obliged to operate in a complex, hostile environment marked by fresh challenges ranging from supply chain disruption and its effects on the food system to satisfying increased market demand and safeguarding the workforce (Coluccia *et al*., 2021; Remondino, Zanin, 2022). The utterly unexpected boom in orders – regarding the whole "organic food" sector (SINAB, 2020) – while having a positive effect in terms of turnover, produced pressure on the firm's production activity, which found itself having to manage a large number of orders with the same company structure but fewer human resources than before (due to the government virus containment measures and sick employees), and no time to reorganise the work.

Both positive and negative aspects of the Covid period combined to instil in the top management "a sense of the urgency of digitalisation".

I'd say that the Covid effect was exactly that … in other words, it made management aware of the need for further investments in production, by increasing efficiency and productivity and investing in human resources and digitalisation precisely because we realised we needed to take that extra step. (IT manager).

Specifically, the impact of the crisis on the implementation of digital technologies prompted management to undertake a series of measures, described below, aimed at accelerating the digitalisation process.

The first concerns the inclusion of newly qualified staff with specific skills, such as an IT manager. This figure made it possible for the firm to manage a whole series of operations itself, which were previously either outsourced or only partially carried out in-house, but mainly it enabled Girolomoni to start up several projects in line with the DT program.

In a firm of our size, having a trained and dedicated IT person is not common, so one of the steps was to bring in a dedicated IT expert. This role used to be carried out by another person who dealt with IT among other things, but it was a marginal task. […] bringing in someone with specific skills was definitely an important step for us. (President).

This figure is now in charge – together with the technical department – of various projects relating to DT, such as the introduction of cybersecurity, business continuity, and the implementation of the MES.

Another measure relates to their partnership with an IT provider. This new collaboration now enables Girolomoni to fill the gaps in the firm's knowledge of digital technologies, in terms of software and hardware. The choice of partner was scrupulously evaluated by the top management.

When you're a small firm, it's easy to rely on outside figures; when you grow, your needs grow, too, and become more complex […] then you need to find a partner who can support the change process. (IT manager).

Investments in staff training were also stepped up. Special attention was paid to production workers (involved in the MES project) who, despite having a thorough technical knowledge of pasta-making, were far less likely to be familiar with the use of digital technologies. In order to overcome this gap, training sessions were organised to introduce, illustrate and explain the new systems, machinery and operating logics, which will gradually be implemented with the MES project.

Implementation of the MES is particularly complex; for this reason, we are organising specific training courses for production staff. (Production director).

The sessions also had the purpose of raising staff awareness as to why and how the firm intended to carry out the digital transformation. This initiative proved very useful in decreasing the resistance to change that often accompanies the introduction of new technologies.

Digitalisation isn't an easy road. The problem always comes down to this; when you start on a course of development, it's crucial that everybody is aware of the road we're going down and that everyone invests in themselves, as it were, in order to carry out the process […]. It's pointless to think of giving a Ferrari to someone who is used to going about in a Panda […] you need to accomplish this transition in terms of training and awareness, to help the workers step by step to understand the importance of what we're doing and to adapt to the change. (IT manager).

5. Conclusions

The agri-food sector is one of the most important industries for the Italian economy. In recent years, this sector has been strongly affected by the development and spread of new technologies (Annosi *et al.*, 2020; Schroeder *et al.*, 2021; Remondino, Zanin, 2022), triggering a radical rethinking of business practices and processes along the whole supply chain.

Scholars have argued that DT applied to the agri-food sector, can assist with monitoring and managing the risks such firms are particularly exposed to (e.g. deterioration rate, supply lead time, weather, diseases, etc.), by improving the firm's performance and also the sustainability of the entire system (FAO, 2018; Hernandez *et al.,* 2018; Annosi *et al.,* 2019; Lezoche *et al.,* 2020; Coluccia *et al.,* 2021; Remondino, Zanin, 2022).

Nonetheless, while the beneficial impact of digital technologies is not questioned, the actual use of new technologies is still unsatisfactory (Annosi *et al.,* 2019; ISTAT, 2019; Bahn *et al.,* 2021), and previous studies have shown low success rates in introducing them (Bahn *et al.,* 2021). DT poses numerous challenges and raises critical issues, which have yet to be addressed (Word Bank, 2019; Annosi *et al.,* 2020; Schroeder *et al.,* 2021), especially in agri-food SMEs.

However, limited research has analysed how firms face the process of digital transformation, especially in the agri-food sector (Annosi, Brunetta, 2020).

With this in mind, this paper has investigated the ongoing digitalisation process within a firm operating in the agri-food sector by analysing the approach adopted for the digital transformation, the barriers and challenges encountered in the implementation of digital technologies, and how the Covid-

19 crisis has impacted this process. Based on a single case study – a medium-sized firm that had already undertaken a DT in the pre-pandemic period – some meaningful results have emerged, offering food for thought on different aspects of the subject.

Regarding RQ1: What is the approach to digital transformation in the agri-food sector? The complexity of the whole digitalisation process is evident, and it was and still is a great challenge for Girolomoni since a transformation of this kind entails great changes that are bound to impact the very soul of the firm: processes, operations, time frames, rationales, tasks, etc. Findings show that an appropriate approach is paramount in ensuring that the evolution process takes place. These findings are in line with the results of other empirical studies (Fitzgerald *et al.*, 2014; Matt *et al.*, 2015; Kane *et al.*, 2015; Hess *et al.*, 2016; Annosi *et al.*, 2020).

For Girolomoni, digital transformation is seen as the means by which it can attain its goals and fulfil its mission. This has meant that, from the outset, management has adopted a proactive approach to it, positively influencing the entire process also in light of the challenges posed by the pandemic crisis. This result is in line with prior studies which posit that the decision to implement new technologies is potentially linked to the values and attitudes of the top management (Lin *et al.*, 2014; Annosi *et al.*, 2019).

The interviews revealed many characteristics typical of the approach adopted by Girolomoni. First of all, a full awareness of the complexity of the digital transformation process and its benefits, economic and otherwise, deriving from the new technologies. Moreover, it is an incremental approach in the sense that all changes should be implemented gradually and systematically and nothing introduced prematurely or radically. The top management has also shown a critical approach towards what is being done today and the initiatives which should be undertaken in the future to maximise benefits. Finally, an innovative approach has emerged, combining digitalisation and craftsmanship. This last characteristic is closely linked to the intrinsic nature of Girolomoni, i.e., a firm that operates according to current market rules but is guided by its founding values and sense of mission.

Overall, the management's proactive approach to digitalisation has allowed Girolomoni to overcome the barriers to the adoption of new technologies, and it has permitted them to turn a challenge, the pandemic crisis, into an opportunity to accelerate the digitalisation they had previously started.

Regarding RQ2: What barriers and challenges are being faced in implementing digital technologies? The case study has identified four main obstacles: resistance of human resources to change, lack of digital skills,

organisational structure and financial constraints. All of them arise from the internal environment.

The first three barriers, concerning human resources, are in line with those highlighted in other studies (Palazzi *et al.*, 2021; Agrawal *et al.*, 2020; Raj *et al.*, 2020; Annosi *et al*., 2020; Schroeder *et al.,* 2021). For Girolomoni these represent a major hurdle to the implementation of digital technologies. The firm is fully aware that the introduction of new technologies has important organisational implications that affect business processes, operations and skills. In fact, Girolomoni has had to deal with: the rejection of 'the new' by many potentially key players in the digitalisation process, the lack of qualified employees and digital competencies at different levels and an organisational structure not fully up to supporting the launch of such a complex and far-reaching transformation.

Furthermore, in keeping with the findings of other empirical studies (Jones *et al.*, 2021; Volgelsang *et al.*, 2019; Annosi *et al*., 2020; Schroeder *et al*., 2021), the financial constraints represent an obstacle in the path of digital transformation. Particularly, the perception of both the outlay required to implement DT and the subsequent running costs appears to be a critical factor (Ghobakhloo *et al*., 2019, Annosi *et al.,* 2020). Although Giromoloni is in good financial health, the higher level of investment required to set in motion the digitalisation resulted in financial constraints, which put the feasibility of the entire process at risk. However, unlike the situation reported in other studies (Parida *et al*., 2010; Raj *et al*., 2020; Annosi *et al*., 2021), the awareness of advantages deriving from such investments by the decision-makers was crucial in preventing the interruption or suspension of the digitalisation project. In this sense, financial constraints were mitigated by top management's ability to be acutely conscious of the benefits deriving from the transformation.

Regarding RQ3: How does the Covid-19 crisis impact the ongoing process towards digitalisation? The findings corroborate what scholars and institutions have pointed out (Modina, 2020; Papadopoulos *et al.*, 2020; ISTAT, 2021): the economic disruption caused by the Covid-19 pandemic proved to be a trigger factor in accelerating the need for digital transformation in firms with a solid financial structure and some previous familiarity with new technologies. Girolomoni's process of digitalisation, already underway in the pre-pandemic period, has been accelerated by the crisis.

As mentioned before, the organic food market has experienced significant growth during the pandemic period: Girolomoni is no exception to this trend. The results of the case study point to two contrasting short-term effects stemming from the sales: the considerable hike in turnover along with the sudden

saturation of production capability and an immediate increase in terms of the complexity of business management. The first effect – the increase in turnover – provided the funds to invest in the human and technological resources needed to overcome some barriers and, as a result, proceed along the path of digital transformation; the second effect – the greater complexity – made top management even more acutely aware of the need to speed up the introduction of new technologies both within the organisation itself and in the agricultural supply chain. Thus, both positive and negative aspects of the Covid period combined to instill in top management "a sense of the urgency of digitalization".

More specifically, the management decided to undertake several measures to accelerate the digitalisation process.

Firstly, hiring newly qualified staff with specific digital skills, such as an IT manager. This move was one of the most important changes and has enabled the firm to integrate pre-existing technical knowledge with new knowledge, thus making it possible to start up a series of projects in line with the DT program (for example, cybersecurity, business continuity, MES, etc.).

Another measure concerns the new strategic partnership with an IT provider to fill the gaps in the firm's knowledge of digital technologies and develop, in terms of software and hardware, the most suitable systems for the needs and characteristics of the firm. Finally, another initiative involved increased investment in staff training, with a twofold objective. First, introducing, illustrating and explaining the new systems and operating logics helped Girolomoni overcome the employees' lack of technological skills; second, raising staff awareness as to why and how the firm intended to carry out the DT helped them decrease that resistance to change which was characteristic of the employees.

This case study offers significant implications. From a theoretical point of view, this empirical analysis contributes to the literature debate on the digitalisation process in the agri-food sector by analysing the approach adopted, the barriers and challenges faced in implementing new technologies and the effect of the Covid-19 pandemic on the process.

Furthermore, findings carry practical implications for decision-makers. By providing empirical evidence regarding the pivotal role played by the leadership in the digital transformation process, this case study can serve as an example for owners and managers intending to implement digitalisation within their firms. Specifically, they should be fully conscious of the challenges and hurdles incidental to this transformation, and they should adopt a suitable approach in order to recognise the new opportunities and advantages

related to the implementation of digital technologies. The case study highlights how digital transformation is consistent with business models based on production methods that are environmentally friendly, sustainable, and socially responsible, as is the organic food sector.

Moreover, given the strategic role of the SMEs and the agri-food sector in the national economy, policymakers should create policies and programs to support firms' digital transformation agendas, by providing counselling and training programs, promoting network creation including different stakeholders, and fostering initiatives aimed at raising awareness of the significant impact of the new technologies on business.

The main limit resides in the analysis of only one case study. Although the case study enables a broader and more in-depth understanding of the phenomenon under investigation, the results obtained cannot be generalised to all the companies operating in the reference sector (Yin, 2003).

This study focuses on a medium-sized enterprise with a developing organisational structure, human and financial resources destined for the digitalisation project, and a top management which evinces a conscious approach to digitalization which was already underway before the Covid-19 pandemic. Thus, these traits may well not be present in micro or small businesses.

Given that digital transformation presents several subjective aspects, the present study could be developed using multiple case studies that may confirm, complement or contrast with the empirical evidence that has emerged. Moreover, primary data were collected by asking the President of the Board of Directors, the IT manager and the Production director to describe their experiences and points of view, but these could potentially be affected by subjective considerations. To better analyse the ongoing process towards digital transformation, future research could take into account a larger number of interviewees that can be considered key informants regarding these specific topics.

Finally, it would be interesting to conduct longitudinal research to observe the evolution of digital transformation in the agri-food sector, understanding whether and how digital technologies have changed their processes, behaviours, mindsets and business models.

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